

# SOME NEMATODES PARASITIC IN AUSTRALIAN FRESHWATER FISH

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The present investigation was undertaken as part of a study of the parasitology of the fauna of the Lower River Murray swamps, especially at Tailem Bend, where we have been most generously assisted for several years past by Messrs. G. and F. Jaensch. Some of our material has been obtained at Murray Bridge and Swan Reach; part of it was collected many years ago at Eidsvold, Upper Burnett River, Queensland, by the late Dr. T. L. Bancroft and his daughter, Dr. M. J. Bancroft (Mrs. Mackerras). We have also examined a small collection belonging to the Australian Museum, Sydney, and placed in our hands by its Director, Dr. C. Anderson, who collected some of it. We also acknowledge gratefully the assistance rendered through the Commonwealth Research Grant to the University of Adelaide.

Our work has included the examination of a large number of individual fish from the lower Murray, as well as parasites obtained elsewhere in Australia. Nematodes from 17 species of fish have been studied, most of them being food fishes, some of them very important, *e.g.*, Murray cod, callop, Murray perch and Murray bream.

Only three species of nematodes had been recorded previously from Australian freshwater fish. The first record was made by Baird in 1861 when he reported the occurrence of a brightly-coloured worm, regarded by him as *Filaria sanguinea* Rudolphi, in a minnow, *Galaxias scribe*, from the Murray River (but not further localised), the first member of the species to arrive in London in a living condition, though dying soon after. Linstow, in 1898, gave an account of *Amblyonema terdentatum* collected by Semon from *Ceratodus forsteri* from the Upper Burnett River. Next year Linstow (1899) described a brightly-coloured worm from *Galaxias attenuatus*, the parasite having been sent to Berlin Museum by Dr. Schomburgk, of Adelaide. This nematode was regarded as identical with *Spiroptera bicolor*, which Linstow had described previously from European freshwater fish. *Galaxias scribe* is a synonym of *G. attenuatus*, and we indicate that the Australian worms identified as *Filaria sanguinea* by Baird and *Spiroptera bicolor* by Linstow may safely be considered as larval stages of a species of *Eustrongylides*, to which we have given the name *E. gadopsis*.

In this paper we deal with 18 species of nematodes, 17 of them being considered new, two of these being larval stages of *Eustrongylides*. A new genus, *Paraseuratum*, is proposed. A number of other larval forms also receive attention, and we hope to be able to associate some of them with adult stages later. Most of the genera to which species are allotted had not previously been recorded as occurring in Australia.

Types of all new species, unless stated otherwise, have been deposited in the South Australian Museum.

## LIST OF PARASITES ARRANGED UNDER THEIR HOSTS

*McCullochella macquariensis* (C. & V.), Murray Cod:—*Capillaria murrayensis* n. sp.; *Contracaecum murrayense* n. sp.; *Contracaecum* sp. (larvae); *Goezia fluviatilis* n. sp.; *Spinitectus* sp. (larvae).

- Plectroplites ambiguus* Rich., callop, golden perch, yellow belly:—*Contracaecum murrayense* n. sp.; *Contracaecum* sp. (larvae); *Goezia fluviatilis* n. sp.; *Spinitectus plectroplites* n. sp.; *Procamallanus murrayensis* n. sp.; *Capillaria plectroplites* n. sp.; *Philometra plectroplites* n. sp.; *Eustrongylides gadopsis* n. sp.
- Percalates colonorum* Gnthr., Murray perch:—*Contracaecum murrayense* n. sp.; *Contracaecum* sp. (larvae); *Capillaria plectroplites* n. sp.; *Goezia fluviatilis* n. sp.; *Spinitectus percalates* n. sp.; *Spinitectus* sp. (encysted larvae); *Procamallanus murrayensis* n. sp.; *Philometra percalates* n. sp.; *Agamonema* sp.
- Macquaria australasica* C. & V., Macquarie perch:—*Contracaecum macquariae* n. sp.; *Spinitectus* sp.; *Philometra* sp.
- Therapon bidyana* Mitchell, Murray bream:—*Capillaria plectroplites* n. sp.; *Contracaecum* sp. (larvae).
- Therapon* sp., black bream from North Queensland rivers:—*Philometra* sp.
- Pseudaphritis urvillei* C. & V., congolli:—*Contracaecum* sp. (larvae); *Spinitectus* sp. (larvae); *Procamallanus murrayensis* n. sp.; *Rhabdochona jacnschi* n. sp.
- Nannoperca australis* Gnthr., pigmy perch:—*Contracaecum* sp. (larvae); *Goezia fluviatilis* n. sp. (larvae).
- Mogurnda adspersa* Castln., gudgeon (Burnett River):—*Contracaecum* sp. (larvae); *Goezia fluviatilis* n. sp. (larvae); *Spinitectus bancrofti* n. sp.
- Carassiops klunzingeri* Ogilby, carp gudgeon (Burnett River):—*Contracaecum* sp. (larvae).
- Gadopsis marmoratus* Rich., black fish, "slippery":—*Eustrongylides gadopsis* n. sp.
- Nematalosa erebi* Gnthr., bony bream:—*Contracaecum* sp. (larvae).
- Galaxias attenuatus* Jenyns, native trout, minnow:—*Eustrongylides gadopsis* n. sp.
- Galaxias olidus* Gnthr., minnow:—*Eustrongylides galaxias* n. sp.
- Anguilla reinhardtii* Strd., long-finned eel:—*Anguillicola australiensis* n. sp.
- Tandanus tandanus* Mitchell, catfish:—*Capillaria tandani* n. sp.; *Contracaecum* sp. (larvae); *Goezia fluviatilis* n. sp. (larvae); *Paraseuratum tandani* n. gen., n. sp.
- Ceratodus forsteri* Krefft, lungfish (Burnett River):—*Amblyonema terdentatum* Linstow.

### *Capillaria plectroplites* n. sp.

Figs. 1-2

Numerous females from mucus on gills of a callop, *Plectroplites ambiguus*; and another from the Murray bream, *Therapon bidyana*; both hosts from Swan Reach. Length, 6.3-7.7 mm.; maximum breadth (near posterior end), 0.09 mm.; width at head .01 mm., at base of oesophagus .06 mm., and at anus .015 mm.; ratio between oesophageal and intestinal regions of body, 4:5. Vulva on projection just behind posterior end of oesophagus; anus subterminal; tail blunt; eggs, 50-53  $\mu$  by 23-25  $\mu$ .

Male worms from the Murray perch, *Percalates colonorum*, at Swan Reach, resemble the females in general appearance. Length, 3.9-4.5 mm.; width at head .01 mm., at posterior end of oesophagus .04 mm., at widest part of body .05 mm., and just in front of bursa .012 mm. End of oesophagus 2.26 mm. from head in specimen 4.49 mm. long. Spicule, .24 mm.; sheath slightly longer; sheath or spicule with transverse striations; exact line between the two structures difficult to determine but striations continue somewhat in front of proximal part of spicule. At end of body two cuticular flaps opening ventrally and extending nearly to tip of tail. Greatest amount of extrusion of sheath observed was .12 mm. Ratio of length of oesophageal region to posterior part of body about 1:1; but in female 4:5, 3:4, 7:9.

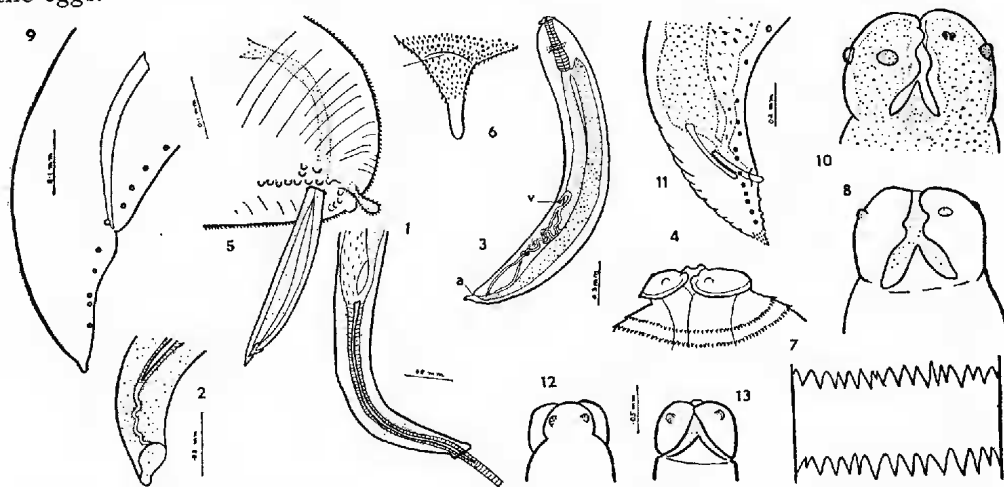
**Capillaria murrayensis** n. sp.

Single female specimen from intestine of Murray cod, *McCullochella macquariensis*, from Tailem Bend. Length, 12 mm.; width at head .009, at vulva .04, at widest part .06, and at tail .025 mm. Vulva at mid-length and just behind end of oesophagus. Eggs, 50-52 by 22  $\mu$ .

The species differs from *C. plectroplites* in its greater length, more attenuated form, and different ratio of the body regions (1:1).

**Capillaria tandani** n. sp.

Four females from intestine of catfish, *Tandanus tandanus*, Tailem Bend. Length, 7.1-8.6 mm. Anterior region of body shorter than posterior part, ratio 1:1.7-2.1. In specimen 8.6 mm. long, breadth at head .01 mm., at end of oesophagus 0.06 mm., in widest region (near tip of tail) .1 mm. Vulva just behind end of oesophagus, not salient. Eggs, 45 by 20  $\mu$ . Body apparently with numerous minute tubercles scarcely projecting through cuticle. The species differs from the two preceding in the ratio of its body regions and in the size of the eggs.



Figs. 1-2, *Capillaria plectroplites*: 1, posterior end of male; 2, bursa. Figs. 3-7, *Goezia fluviatilis*: 3, young female; 4, head of female; 5, tail of male; 6, tail of female; 7, part of cuticle in region of posterior oesophagus, showing spines. Figs. 8-9, *Contracaecum macquariae*: 8, head of young male; 9, tail of young male. Figs. 10-13, *Contracaecum murrayense*: 10, head of male; 11, posterior end of male; 12, dorsal, and 13, ventral views of head of very young female. Figs. 1, 4, and 6, to same scale; figs. 2 and 7. Figs. 8 and 9 to same scale; figs. 10, 12, and 13.

REFERENCES TO LETTERING—*a*, anus; *ep*, excretory pore; *g*, gubernaculum; *n*, nerve ring; *o*, ovarian tube; *u*, uterus; *v*, vulva.

**Goezia fluviatilis** n. sp.

Figs. 3-7

Females from gill mucus, *Plectroplites ambiguus* and *McCullochella macquariensis*; males from *Percalates colonorum*, Tailem Bend.

Female adult 4.4-6 mm. long, young specimens 2.2-4 mm.; males 3.4-4 mm. long. Lips three, marked off from body by deep constriction, outer edge with cuticular expansion, inner border prolonged into two short rounded cuticular structures (possibly serving as teeth); dorsal lip with two papillae; ventral lips each with at least one papilla. Body widening rapidly behind head, then con-

terminating at same breadth nearly to posterior end, then narrowing to tail, terminating in cylindrical tip. Rows of spines approximating towards posterior end of body, spines becoming smaller and more closely set; spines no longer arranged in definite rows in vicinity of anus; spines absent from distal half of cylindrical part of female tail.

In male 4.4 mm. long, width at head .2 mm., at mid-length of body .65 mm. Oesophagus .6 mm. long, club-shaped; oesophageal appendix 1.4 mm. long; caecum conical, .15 mm. long. Spicules .65 mm. long, with wide alae extending beyond their tips like arrowheads. Tail .14 mm. long, cylindrical part .06 mm. Five pairs preanal and three pairs adanal papillae; also three papillae arranged on each side laterally from the adanals.

In a young female 2.4 mm. long, breadth at head .16 mm., at mid-body .4 mm.; oesophagus .4 mm. long (.75 mm. in female 4.4 in length), ratio to body length 1:6; nerve ring surrounding oesophagus just before latter widens at .2 mm. from head end; oesophageal appendix 1.1 mm. long; caecum .08 mm. Tail .11 mm. long. Uteri extending forward and uniting a short distance behind oesophagus to form median uterus which passes back to vulva; latter 1 mm. in front of anus in specimen 2.5 mm. long, dividing body length in ratio 3:2. Eggs, roughly globular, some with embryo. The position of the vulva and the equality of the spicules do not conform with the generic diagnosis for *Goezia*, but the differences are too slight to prevent the inclusion of the species in that genus.

Immature stages, probably belonging to *G. fluviatilis*, have been found in *Nannoperca australis* and *Tandanus tandanus* from Tailem Bend, and in *Mogurnda adspersa* from the Upper Burnett River, Queensland.

The specimen from *Tandanus* was an encysted larva, 1.35 mm. long, .05 mm. in maximum breadth, contained in a cyst .38 by .4 mm. in the omentum. A larval tooth was present, and the rows of spines as well as the form of the anterior end were readily recognisable.

The immature worm from the intestine of *Mogurnda* measured 2.8 mm. long, with a maximum diameter .2 mm. The truncated anterior end possessed a prominent larval tooth. The rows of minute spines extended from the head to the tip of the conical pointed tail. The latter was .3 mm. long; the oesophagus .36 mm., its appendix .45 mm., and the intestinal caecum .2 mm. in length. The specimen from *Nannoperca* was a moulted skin.

### ***Contracaecum macquariae* n. sp.**

Figs. 8-9

From stomach of the Macquarie perch, *Macquaria australasica*, Goodradigbee River, New South Wales, collected by Dr. C. Anderson, Director, Australian Museum, Sydney. (Austr. Museum Coll., W. 2820.)

Male 15 mm. long; female 20-25 mm. long. Lips large, each with two pairs of narrow lateral flanges; interlabia conical, less than half length of lips; two papillae on dorsal lip, one on each subventral. No collar region, but head distinctly narrower than rest of body.

*Male*—Oesophagus 4.5 mm. long, straight, narrow, with club-shaped appendix 1.5 mm. long; caecum 3 mm. long. Nerve ring, cervical papillae and excretory pore not observed. Testis commencing just behind oesophagus. Tail conical 2.4 mm. long. Spicules 2.8 mm.; 8-10 pairs small preanal papillae in region extending 4.5 mm. in front of anus, five pairs postanal arranged laterally (fig. 9). *Female*—Tail .6 mm. long, tapering, ending in papilla. Vulva not observed.

Type deposited in the Australian Museum, Sydney.

**Contracaecum murrayense** n. sp.

Figs. 10-12

Single male from *McCullochella macquariensis*; females from *Percalates colonorum*, both fish from Tailem Bend. Head about as wide (.15 mm. in male) as neck, without 'rolled collar' so commonly present in genus. Lips about .16 mm. long, each with pair of lateral flanges; dorsal lip with two wide papillae; subventrals each a wide papilla ventrally and a pair of minute closely-set papillae on their anterior dorsal side; interlabia short, conical.

Male 12.8 mm. long, .38 mm. maximum breadth. Oesophagus 3.5 mm. long, appendix about 1.3 mm.; caecum 2.6 mm. long. Nerve ring at .5 mm. from head end and just in front of excretory pore. Tail .3 mm. long, .3 mm. wide at base, tapering to point, provided for the last .08 mm. of length with short spines of varying sizes. Spicules equal, .35 mm. long, of similar form, each with stout head followed by cylindrical shaft with rounded distal end. Nine pairs of lateral papillae, five postanal, four preanal; a more medianly-placed row of eight or nine pairs in front of the latter and spaced further apart to reach a point about 1.5 mm. in front of cloaca.

Females 16-18.3 mm. long; oesophagus about one-sixth body length; appendix .45 mm., thin; caecum 2.1 mm. Nerve ring about .5 mm. from head end. Tail pointed, .53 mm. long, with tip ornamented as in male. Vulva .7 mm. from head end (1:2.6 of body length); uteri backwardly directed. Eggs not present.

Though this species possesses many of the characters of the subgenus *Thynnascaris* Dollfus 1933—e.g., the long oesophagus with a posterior bulb, short interlabia and equal spicules—it has been deemed preferable to place it under *Contracaecum*.

Young female worms obtained from *Plectroplites ambiguus*, at Tailem Bend, agreed with most of the specimens described above in most features except that they were much shorter, and in the case of very young specimens the interlabia were relatively shorter, with a broader base. The tails were provided with numerous spines.

**CONTRACAECUM** spp. (larvae)

Larvae in various stages of development were found in *McCullochella macquariensis*, *Plectroplites ambiguus*, *Percalates colonorum*, *Tandanus tandanus*, *Therapon bidyana*, *Nematalosa erebi* and *Pseudaphritis urvilei*, all from the Lower Murray, as well as *Carassiops klunzingeri* and *Mogurnda adspersus* from the Upper Burnett River, Queensland. Some were encysted in the mesentery and omentum, and possessed small lips, distinct alimentary canal with appendix and caecum, as well as (usually) distinct genital primordia, the almost spherical cyst measuring about 1 mm. in diameter. Others occurred free in the intestine, some of them with a larval tooth, but otherwise resembling the encysted forms. It is possible that more than one species of *Contracaecum* was represented and the adult stage may be expected to be found in fish-eating water birds.

Measurements (in mm.) of specimens from the mesentery of the Murray perch (*Percalates*), from the lumen of the intestine of the callop (*Plectroplites*), and from cysts in the omentum of the catfish (*Tandanus*), are now tabulated.

Host	Murray Perch	Callop	Catfish
Length - - -	3.25	3.35	3.34
Maximum diameter -	.15	.16	.15
Oesophagus - -	.36	.45	.4
Oesoph. appendix -	.3	.35	.35
Int. caecum - -	.2	.3	.2
Head to genit. anlage -	?	1.1	1.3
Tail length - -	.1	.1	.1

**Spinitectus plectroplites** n. sp.

Fig. 14

Females from gill mucus of *Plectroplites ambiguus*, Tailen Bend. Length, 8.8.5 mm. First three rows with largest body spines, succeeding three rows with smaller spines, remaining rows with spines diminishing in size, becoming very small at level of posterior end of oesophagus and remaining so to end of body. Mouth with two lateral lips; vestibule 50  $\mu$  long, 15  $\mu$  wide. Oesophagus with anterior narrower part, .18 mm. long, and posterior region .55 mm. long. Nerve ring at .12 mm. from head end and just behind third row of spines. Excretory pore .15 mm. from head end and opening at base of spine in fourth row. Tail .11 mm. long, tapering, pointed. Vulva near posterior end, .3 mm. from tip of tail. Uteri uniting very near vulva, vagina very short. Eggs oval, smooth-shelled, 31-34 by 20-21  $\mu$ . The species differs from *S. gracilis* Ward and Magath 1916 in length, position of vulva, length of anterior region of oesophagus, and distribution of spines.

**Spinitectus percalates** n. sp.

Figs. 15-16

From *Percalates colonorum*, Lower Murray River. The species differs from the preceding in the length of the buccal capsule, position of the nerve ring, and size of spines. The size of the female, the length of its tail and the position of the vulva are similar to those of *S. plectroplites*.

Male 6.6 mm. long; vestibule 40  $\mu$  long, 9  $\mu$  wide, not extending back as far as first row of spines. 20-22 spines in each row. Oesophagus, anterior region .17 mm., posterior region .5 mm. long. Nerve ring at level of fourth row of spines, .13 mm. from head end. Tail .14 mm. long, tapering to narrow tip. Spicules simple, tapering to a point, stouter spicule .15 mm. long, the other .09 mm. Papillae, 11 pairs arranged in two lateral rows each with four preanal, three postanal, and a group of four smaller caudal.

## SPINITECTUS sp.

In *Percalates* and the Murray cod, as well as in the congolli, *Pseudaphritis urcillei*, Tailen Bend, immature encysting female worms of *Spinitectus* sp. were collected, but details regarding the structure of either end were not sufficiently recognisable to permit identification with the species described above.

**Spinitectus bancrofti** n. sp.

Figs. 17-18

A male and several indifferently preserved females from the intestine of *Mogurnda adspersa*, Upper Burnett River. Coll., Dr. M. J. Bancroft (Mrs. Mackerras).

Male, 7.1 mm. long, .09 mm. maximum width. Female, 5.4-6.8 mm. Spines distinctly smaller than in the two preceding species, and commencing more posteriorly at .09 mm. from the head end; each row with 26-28 spines, rows about 20  $\mu$  apart at anterior end, becoming closer and containing smaller spines behind level of mid-oesophageal length, but rows more separated near mid-body; spines extremely small and rows far apart and scarcely recognisable near tail. Vestibule bent, 40  $\mu$  long, 10  $\mu$  wide. Nerve ring at level of second row of spines, .1 mm. from head end. Oesophagus, anterior region .15 mm. long and ending at level of fifth or sixth row of spines, posterior part .45 mm. long. Male, tail .11 mm. long, spicules unequal, .17 and .055 mm. long; four pairs preanal and at least five pairs postanal papillae, all pedunculated and projecting into narrow caudal alae.

Females, all specimens young and without eggs; tail  $\cdot 07$  mm., constricted suddenly, then tapering behind anus to end in blunt point; vulva  $\cdot 2$  mm. from tip of tail.

The species is distinguished from the two preceding by the much greater distance from the head at which the rows of spines commence, the smaller size and greater number of the spines, the position of the nerve ring, and the spicular lengths.

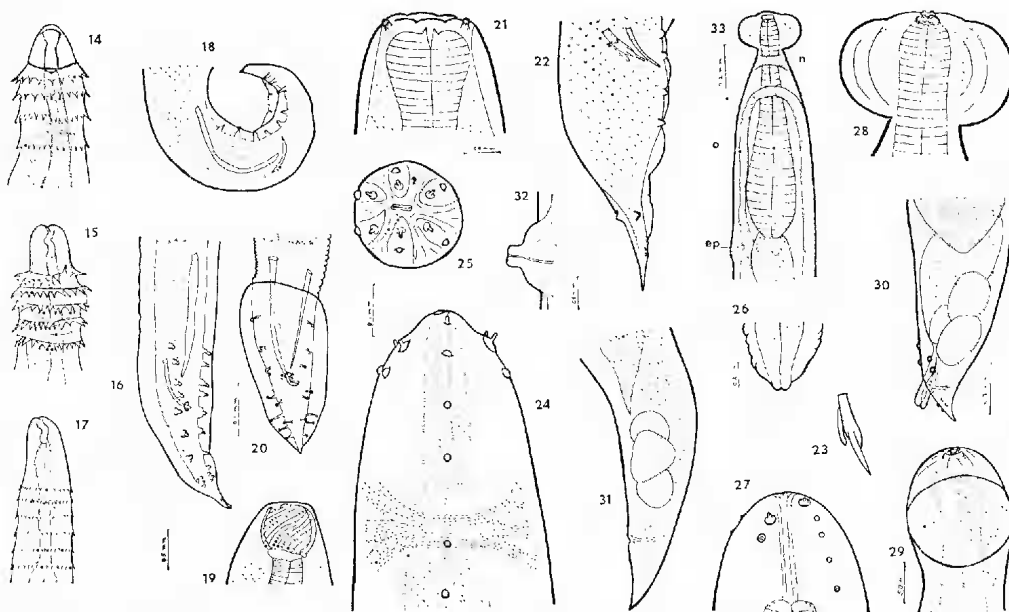


Fig. 14, *Spinitectus pectroplites*: head. Figs. 15-16, *Spinitectus percalotes*: 15, head; 16, tail of male. Figs. 17-18, *Spinitectus bancrofti*: 17, head; 18, tail of male. Figs. 19-20, *Procamallanus murrayensis*: 19, head; 20, tail of male. Figs. 21-23, *Parascuratum landani*: 21, head; 22, tail of male; 23, one spicule and gubernaculum. Figs. 24-26, *Eustrongylides gadopsis*: 24, head, lateral view; 25, head, anterior view; 26, posterior end of female. Fig. 27, *Eustrongylides galaxias*: head. Figs. 28-33, *Anguillicola australiensis*: 28, head, lateral view; 29, head, ventral view; 30, tail of male; 31, tail of female; 32, vulva; 33, anterior end. Figs. 14, 15, 16, 17, 18, and 19 to same scale. Figs. 22, 24, 25 and 27 to same scale; figs. 23, 28 and 29; figs. 30 and 31.

#### SPINITECTUS sp.

A damaged female from the stomach of *Macquaria australasica* from the Goodradigbee River, New South Wales, collected by Dr. C. Anderson. (Austr. Museum Coll., W. 2820.) The worm at first sight suggested a *Trichuris*. The thin incomplete anterior end measured 9 mm. long and the wider posterior region, containing abundant eggs, 7.4 mm. Anterior end with transverse rows of spines; latter becoming smaller posteriorly and at 2 mm. almost disappearing, but discernible again as very small structures on the tail. Oesophageal regions not distinguishable. Body width anteriorly  $\cdot 06$  mm., where the spines measure about  $7 \mu$  long; at 8 mm. from anterior end width is  $\cdot 14$  mm., at 9 mm.  $\cdot 19$  mm., at level of anus  $\cdot 06$  mm. Maximum breadth (near vulva)  $\cdot 27$  mm. Anus  $\cdot 12$  mm. from tip of tapering, bluntly pointed tail; vulva on prominence  $\cdot 21$  mm. in front of anus. Eggs,  $\cdot 04$  by  $\cdot 02$  mm., ovoid, thick-shelled, without polar plugs.

The characters of this incomplete, poorly preserved parasite suggest a new species of *Spinitectus*, but in view of its condition we abstain from naming it.

**Procamallanus murrayensis** n. sp.

Figs. 19-20

From *Pseudaphritis urvillei* from Swan Reach, *Percolates colonorum* from Murray Bridge, and *Plectroplites ambiguus* from Tailem Bend. Male 4-5 mm. long, .13 mm. maximum breadth; female 8-10 mm. long, .25-.3 mm. maximum breadth. Buccal capsule spirally striated, not markedly compressed laterally, 70  $\mu$  long, 70  $\mu$  diameter at its mid-length, base greatly thickened, anterior edge moulded into six lobes. Oesophagus in male with anterior muscular region terminating .4 mm. from head, glandular portion ending at .9 mm. from head, both parts with more or less pronounced curve in their most anterior portions. Nerve ring about .2 mm. from head.

*Male*—Caudal alae membranous, joined ventrally as in *Physaloptera*, .33 mm. long. Papillae, three pairs preanal, two pairs pedunculated postanal, two pairs sessile adanal. Cloaca .15 mm. from tip of tail. Spicules .29 and .2 mm. long, simple, tapering, pointed.

*Female*—Tail .1 mm. long, with narrow tip 30  $\mu$  long and 10  $\mu$  wide; two minute lateral papillae 50  $\mu$  from tip of tail; vulva a transverse slit just in front of mid-length of body; uteri opposed.

The species resembles *P. spiralis* Baylis 1923 in some features, but differs in the form of the buccal capsule, which is more spherical.

**Paraseuratum tandani** n. g., n. sp.

Figs. 21-23

A male and a few females, some poorly preserved, from *Tandanus tandanus* from Tailem Bend. Male 8.7 mm., female 5.5-8.5 mm. long. Anterior end truncated, tapering; six low lips, each with small papilla. Buccal capsule absent; vestibule very short. Oesophagus .9 mm. long in male, commencing with dilatation followed by narrow tube widening at base; six short conical teeth projecting from anterior end into vestibule. Nerve ring at about mid-length of oesophagus. Excretory pore and cervical papillae not seen.

*Male*—Spicules equal, similar, .11 mm. long; proximal half spoon-shaped; distal half simple, tapering to point. Gubernaculum 0.05 mm. long. Caudal alae arising about 2 mm. in front of cloaca and extending each as narrow wavy band to within .05 mm. of tip of tail. Papillae; four pairs preanal (at .55, .2, .06 and .02 mm. respectively in front of cloaca); five pairs postanal, two pairs of these near anus, behind these the tail narrowing suddenly and bearing a pair of large dorso-lateral and two pairs of ventro-median papillae before ending in a fine spike. Cloaca .45 mm. from tip of tail.

*Female*—Tail .5 mm. long, tapering, ending in short spine curving somewhat ventrally. Vulva salient, 3.2 mm. from posterior end, in worm 8.5 mm. long, i.e., 1:1.7 of body length from head end; vagina short; uteri opposite; eggs more or less globular, .05-.06 mm. diameter.

This species does not fall into any previously described genus of Spiruroidea, so we propose a new genus, **Paraseuratum**, with the following characters:—*Seuratinac*; mouth surrounded by six low lips each with a small papilla. No longitudinal dark bands on cuticle. Buccal capsule absent; oesophagus long, with six short teeth projecting anteriorly into mouth cavity. Male with short narrow caudal alae, short spicules, and pointed tail. Female with tapering tail, vulva in second third of body length, and eggs subglobular. Type, *P. tandani* n. sp.

The appearance of the anterior end and the male tail is nearest to that of *Seuratum*; but from the latter our worms differ in having a longer oesophagus,



six lips, and no longitudinal dark bands on the cuticle. Baylis (1923) placed *Seuratium* in the Cnecullanidae. *Seuratium* and *Paraseuratium* differ from the other genera of the family in the absence of a vestibular enlargement of the oesophagus and in the absence of a preanal sucker in the male.

***Rhabdochona jaenschi* n. sp.**

Figs. 37-38

Two specimens from a *Pseudaphritis urvilliei* taken from the stomach of a Murray cod at Tailem Bend. Male, 2.55 mm.; female, 4.4 mm. long; of uniform diameter except at both ends, tapering at head end, narrowing suddenly at posterior end; maximum diameter of male 60  $\mu$ , of female 80  $\mu$ . Head rounded, with two small papillae. Mouth succeeded by elongate cylindrical pharynx, probably unarmed; .1 mm. long in female. Oesophagus .8 mm. long in female, about one-fifth body length, with narrower anterior part .16 mm. long. Nerve ring at anterior end of oesophagus.

*Male* with caudal alae, about .16 mm. long, each .012 mm. wide; tail .07 mm. long, alae meeting at its tip. About three pairs preanal and five or six pairs postanal papillae, all pedunculated but not all reaching edge of alae; exact number doubtful because of position of alae in the single specimen. Spicules dissimilar, unequal; one being 30  $\mu$  long, spatulate, with blunt tip; the other 95  $\mu$  long, cylindrical for proximal half, tapering in distal half. Gubernaculum about 10  $\mu$  long, shield-shaped.

*Female* with blunt tail about .1 mm. long, ending in small round papilla. Vulva 2.1 mm. from posterior end and just behind mid-length of body. Eggs oval, 30 by 20  $\mu$ , with very thick shell.

The assignment of this species (named as an acknowledgment of the generous assistance rendered by Messrs. G. and F. Jaensch of Tailem Bend) to *Rhabdochona* is provisional, since it differs from members of the genus in possessing caudal alae. We were not able to observe any teeth at the anterior end of the pharynx.

**AMBLYONEMA TERDENTATUM Linstow 1898**

(Figs. 39-40)

Several specimens collected by the late Dr. T. L. Bancroft from *Ceratodus forsteri* from the Upper Burnett River, Linstow's type host and locality. Male, 10.1 to 12.8 mm. long; female, 12.1 to 15.4 mm. long. Head with six rather large papillae (not mentioned by Linstow); inside of buccal cavity indistinct, only outlines of part of teeth visible. Lips conical, shorter than in Linstow's figure. Oesophagus commencing at about 50  $\mu$  from anterior end.

*Male* with pointed tail; spicules (in specimen 10.1 mm. long) .34 mm. in length (Linstow, .137 mm.), gubernaculum .09 mm. long (Linstow, .11 mm.). Two pairs preanal and one pair postanal papillae (as stated by Linstow); in addition, three pairs more anteriorly situated than the preceding, a pair laterally near tip of tail, and a pair ventro-laterally (also near tip of tail), last pair on slight projection.

***Philometra plectroplites* n. sp.**

Fig. 34

Two mature females from body cavity of *Plectroplites ambiguus* from Murray Bridge. Longer worm 10.5 cm.; cuticle with numerous minute, irregularly distributed bosses. Anterior end rounded, without lips and papillae. Oesophagus 1.05 mm. long, .09 mm. broad; anterior end widened to contain small, nearly hemispherical, vestibule, 56  $\mu$  wide, 48  $\mu$  long. Nerve ring .2 mm. from

head end. Vulva and anus atrophied. Uterus voluminous, occupying most of body cavity; merging into an oviduct about .5 mm. from head end. Larvae in uterus about .022 mm. wide, .47 mm. long; coiled in two complete spirals; anterior end rounded; tail tapering to fine point.

***Philometra percalates* n. sp.**

Figs. 35-36

A male 2.6 mm. long from *Percalates colonorum*, Tailern Bend. Anterior end rounded, with eight small papillae; posterior end truncate. Oesophagus .25 mm. long, with swollen anterior end succeeded by narrow region to nerve ring (.15 mm. from head end), then terminating in wider portion. Spicules .105 mm. long, with narrow alae; gubernaculum .04 mm. long, with barbed tip. Tail with four lobes, ventral pair longer, dorsal pair more pronounced.

This male may belong to the preceding species, but as the two sexes were not obtained at the same time, and the hosts belonged to different species, it has been deemed advisable to describe the worms separately.

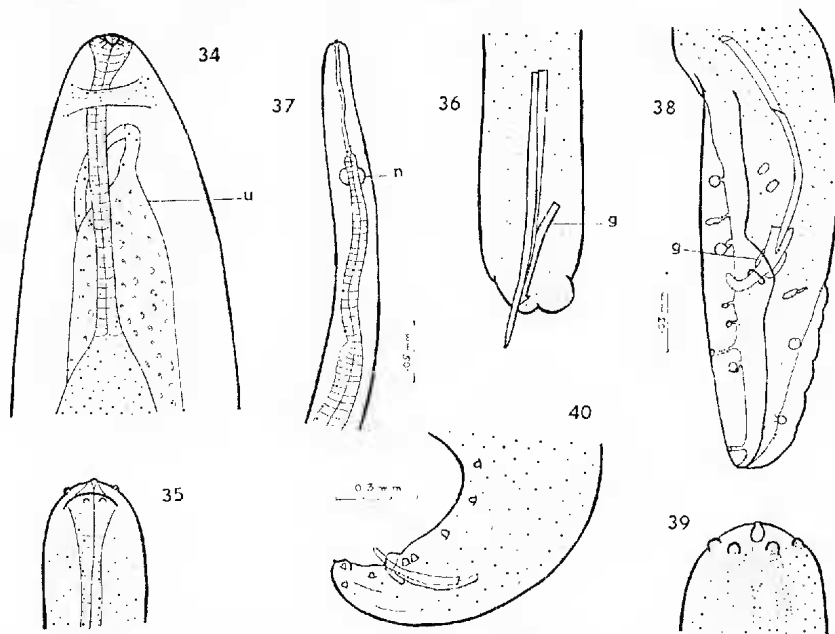


Fig. 34, *Philometra pectroplites*: anterior end. Figs. 35-36, *Philometra percalates*: 35, male, anterior end; 36, male, posterior end. Figs. 37-38, *Rhabdochona jaenschi*: 37, anterior end; 38, tail of male. Figs. 39-40, *Amblyonema terdentatum*: 39, head; 40, tail of male. Figs. 34 and 40 to same scale; figs. 35, 36 and 38; figs. 37 and 39.

*Philometroides* Ishii differs from *Philometra* in the absence of papillae, the presence of cuticular bosses, and the enlargement of parietal muscles in the former genus. Bosses have been noted in several species of *Philometra*—*nodulosa*, *parasiluri*, *sanguinea* and *senticosa*, the first two of which possess oral papillae (six and eight respectively), while the other two do not. The condition of the parietal muscles is not usually noted in the various species of *Philometra*. The male of *Philometroides* is unknown. The absence of essential literature has prevented us from reviewing adequately the species recorded under *Philometra*, but Furayama's paper (1932) relating to *P. fugimotoi* gives much useful information. We prefer to leave our two species under *Philometra* for the present.

## PHILOMETRA spp.

A very long thin worm collected by Dr. C. Anderson from *Macquaria australasica*, Goodradigbee River, New South Wales (Austr. Museum Coll., W. 2820) belongs to the genus. It is broken, one fragment measuring 580 mm. and another 50 mm., each piece possessing a smoothly rounded end, but internal structure was not recognisable.

Another worm (Austr. Museum Coll., W. 1587), 45 mm. long, from a "black bream" (presumably *Therapon* sp.), collected by Dr. Hall in a tributary of the Mitchell River, North Queensland, probably belongs to *Philometra*, but its condition does not permit a study of its structure.

***Eustrongylides gadopsis* n. sp.**

Figs. 24-26

Several long, thin, immature specimens from *Gadopsis marmoratus* from Orange, New South Wales (Austr. Museum. Coll.). Length, 70-80 mm. Anterior end domed; mouth elongated dorso-ventrally; four submedian and two somewhat elongate lateral papillae, laterals smaller and nearer mouth; row of long rounded papillae on each side anteriorly, becoming much smaller posterior to oesophagus and gradually diminishing till they disappear. Vestibule slightly cuticularized, .35 mm. long; oesophagus very long, about 15 mm., one-fifth body length; nerve ring .4 mm. from head end. Body narrowing suddenly near posterior end to terminate in small prominence bearing anus. Type deposited in Aust. Mus. (Reg. No. W. 3235).

A similar worm, 55 mm. long, was found in the freshwater perch, presumably *Plectroplites ambiguus*, by Dr. Hall in a tributary of the Mitchell River, North Queensland (Austr. Museum Coll., W. 1588).

Our species is the same as that described by Linstow (1899, 17) from *Galaxias attenuatus* from Adelaide, under the name ? *Spiroptera bicolor*. He had previously (1873, 298) described ? *Filaria bicolor* from European fish (*Esox*, *Silurus*), but in his later work (1899) he considered the parasite as ? *Spiroptera* and, though he mentioned *Silurus* as one host, he based his account on the Australian worm and gave several figures relating to it. The arrangement and form of the lips agree essentially with those of our specimens. We think it likely that his name was applied to larval stages of two distinct, but closely related, species of *Eustrongylides*. Since the name *Filaria bicolor* was already preoccupied by *F. bicolor* Creplin 1825 (also from European freshwater fish), Linstow's name was not valid. Chitwood (1933) renamed it *Eustrongylides linstowi*. The latter name must be attached to the parasite from *Esox* and *Silurus*, if distinct from the Australian parasite. Ciurea (1924) recognised Linstow's worm as a larval *Eustrongylides* and published figures of larvae belonging to the genus, some of his illustrations showing resemblance to our parasite. Cram (1927) listed *Spiroptera bicolor* Linst. as a synonym of *E. ignotus* Jägersk. Baird in 1861 referred to the presence of *Filaria sanguinea* Rud. (originally described as an adult worm from *Cyprinus* in Europe) in *Galaxias scribea* from the Murray River, and (1862 a, 207-8; 1861 b, 269-70) gave a brief account of it. Rudolph's species has been placed under *Philometra*, but Jägerskiöld (1909) mentioned that larvae from *Galaxias scribea* resembled *Eustrongylides ignotus* whose adult hosts are Ardeiform birds. *Galaxias scribea* is a synonym of *G. attenuatus* according to McCulloch (Mem. Austr. Museum, 5 (1), 1929, 47).

In view of the foregoing statements we apply the name *E. gadopsis* to the brightly-coloured larval parasite from *Gadopsis marmoratus* from New South Wales, *Plectroplites ambiguus* from Northern Queensland and *Galaxias attenuatus*

from South Australia, its synonyms being ? *Spiroptera bicolor* Linstow from *Galaxias* and *Filaria sanguinea* Baird (nec Rudolphi), also from *Galaxias*. The name *Eustrongylides linstowi* should be restricted to the parasite first described from the European catfish, *Silurus glanis*, unless it be proved identical specifically with the worm from Australian freshwater fish. We may mention that we have studied a related species from *Galaxias olidus*, described below.

### ***Eustrongylides galaxias* n. sp.**

Fig. 27

An immature worm from *Galaxias olidus* from the vicinity of Adelaide, closely resembling the preceding species. Length 120 mm., breadth .74 mm. Papillae on head and lateral lines as in *E. gadopsis* but smaller. Vestibule .2 mm. long,  $25\mu$  external diameter,  $9\mu$  internal diameter, anterior border appearing deeply serrated with six tooth-like projections. Oesophagus 23 mm. long. Posterior end rounded, anus terminal.

### ***Anguillicola australiensis* n. sp.**

Figs. 28-33

Several worms from swim bladder of *Anguilla reinhardtii*, from Prospect Reservoir, near Sydney, New South Wales. Gravid females, 60-70 mm. long, 1.5 mm. wide; young females 25-30 mm. by .5 mm.; males 40 mm. long, 1 mm. maximum breadth. Head end resembling the extruded bulbous proboscis of some echinorhynchs; marked neck constriction; body tapering at posterior end to a pointed tail. Anterior bulbous enlargement much wider dorso-ventrally than from side to side, hence different appearance when viewed laterally or dorso-ventrally; in female 25 mm. long this swollen region measured .14 mm. long, .22 mm. dorso-ventrally, and .13 mm. from side to side. Mouth with six small lips or papillae; buccal cavity wider at base than anteriorly, with serrated anterior edge suggesting a leaf-crown with many elements; capsule  $10\mu$  long,  $28\mu$  wide at mid-length. Oesophagus .82 mm. long, about 1:30 of body length; strongly muscular; widening regularly toward base; anterior end with six lobes projecting into buccal cavity. Nerve ring at .18 mm. from head end, i.e., just behind head swelling. Excretory pore on prominence in region of posterior end of oesophagus. Intestine very wide, filled with dark material. Actual position of anus in female not observed, but at .4 mm. from tip of tail in worm 25 mm. long, and at a corresponding distance in larger worms, there is a slight indentation associated with a muscular band extending across the body; in front of indentation are four large glandular masses; anteriorly to the latter, at 1.1 mm. from tip of tail, the dark intestinal material is no longer evident; hence rectum probably a very narrow tube.

In two specimens which showed a similar disposition of pigment and glands, there appears to be a projection of the rectal wall through the anus, i.e., at the point of attachment of the transverse musculature. These worms have a regular arrangement of papillae, two pairs preanal and two pairs postanal. We regard these specimens as males, although spicules were not seen. In a tube leading towards the anus numerous small spherical bodies, probably sperms, were noticed. Perhaps the projecting part of the rectal wall has replaced functionally the spicules.

In the female there is a rounded projection of the body wall, distant from the posterior end one-sixth of the body length, this prominence being surrounded by obvious lips, so that in the gravid worm the vulva is visible to the unaided eye. The ovarian tubes extend into the oesophageal and tail regions respectively. The thin-shelled eggs measure 12-15  $\mu$  by 25-26  $\mu$ .

Our species appears to be more closely related to *Anguillicola globiceps* (Anguillicolidae) described by Yamaguti (1935) from the swim-bladder of a Japanese eel, but differs mainly in the markedly swollen anterior end and in the form of the tail.

AGAMONEMA sp.

Very young nematodes, not further determinable, were taken from the eyes of *Percalates colonorum* from Tailem Bend. No organs, other than the alimentary canal, were recognisable. Length .42 mm.; maximum breadth (at lower end of oesophagus) .02 mm.; truncated head; head structures apparently absent; oesophagus .15 mm. long; tail .06 mm. long, tapering to a point.

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